

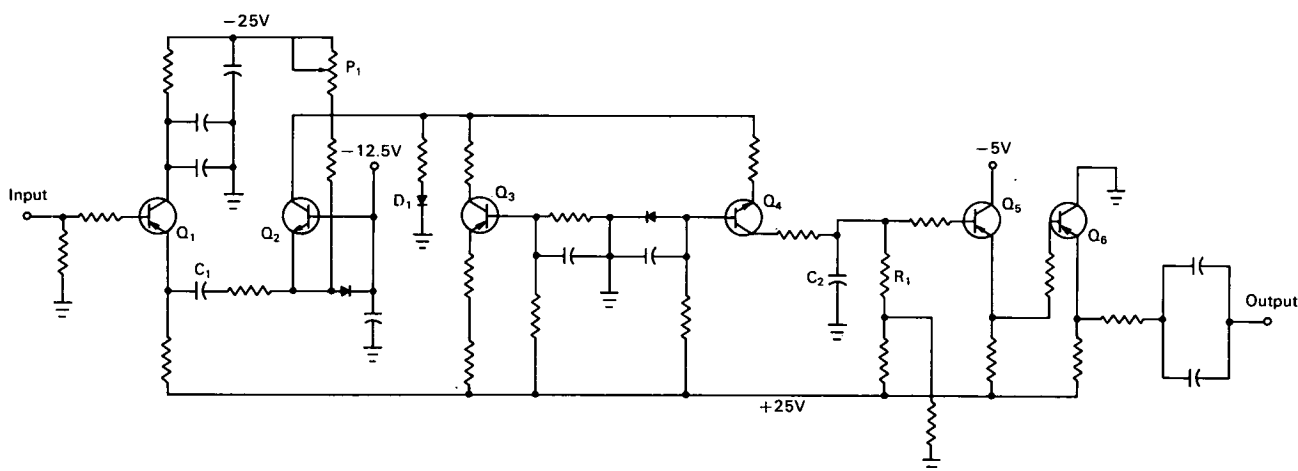


AEC-NASA TECH BRIEF



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Pulse Stretcher Has Improved Dynamic Range and Linearity



The problem:

To lengthen nanosecond pulses so that their amplitude may be determined and to extend the dynamic range of the pulse stretcher. The most serious limitation of the commonly used diode-capacitor stretcher is the nonlinear attenuation of the diode for signals of less than a few hundred millivolts. Also, when operating in the nanosecond range the diode capacitance allows partial feedthrough of the signal to produce distortion.

The solution:

A current-switching pulse stretcher to overcome the diode nonlinearity and capacitive feedthrough of voltage switching diode-capacitor stretchers.

How it's done:

The figure shows the complete circuit of the current switching nanosecond pulse stretcher. When no input is present, the quiescent operating conditions are such

that Q_2 and Q_3 are biased into the active region. The quiescent current in Q_2 is adjusted with P_1 so that D_1 conducts approximately 10 microamperes. Since D_1 draws little current, the emitter potential of Q_4 is nearly zero and Q_4 is held in cutoff.

An input pulse enters through the base of emitter follower Q_1 . Q_1 drives the differentiating capacitor C_1 . A current proportional to the derivative of the input voltage passes through Q_2 to the diode switching circuit, D_1 and Q_4 . The signal current switches D_1 off and turns Q_4 on. The output from the collector of Q_4 rapidly charges C_2 . As the differentiated pulse returns to zero, Q_4 turns off, leaving a charge on C_1 . When Q_4 is turned off, C_2 discharges exponentially through R_1 , with a time constant of approximately $R_1 C_2$. R_1 is selected to give the desired decay time of the stretched pulse. The input impedance of emitter followers Q_5 and Q_6 is high compared to R_1 and therefore isolates C_2 from the output load.

(continued overleaf)

The voltage swing at the emitter of Q_4 is small so that the effect of capacitive feedthrough from emitter to collector of Q_4 during the trailing edge of the input is negligible. There is a slight threshold in the circuit due to the 10-microampere quiescent current in D_1 , as well as the charge which is lost in charging the stray capacitance across D_1 . This effect is made quite small by choosing C_1 large enough so that the full scale current pulse is large compared to 10 microamperes.

Notes:

1. The rise time of the output pulse in response to a step function is approximately 5 nanoseconds.
2. The differential linearity of the output is 1-2 percent over an output range of 50 millivolts to 10 volts.
3. Additional information is contained in *Rev. Sci. Instr.*, vol. 37, no. 4, p. 514-515, April 1966.

4. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 S. Cass Avenue
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Reference: B66-10509

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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